23K-0019

# AI ASSIGNMENT

Date

Q2:

⇒ Population initialization:

$C_1 = [1, 3, 1, 2, 3, 2, 1]$

$C_2 = [3, 2, 2, 1, 1, 3, 2]$

$C_3 = [3, 3, 2, 2, 1, 1, 3]$

$C_4 = [1, 1, 2, 3, 1, 2, 2]$

$C_5 = [1, 3, 3, 1, 1, 1, 2]$

$C_6 = [2, 2, 3, 2, 1, 1, 3]$

⇒ Evaluate Fitness:

| Chromosome | Task1 | Task2 | Task3 | Task4 | Task 5 | Task 6 | Task 7 |
|---|---|---|---|---|---|---|---|
| $C_1$ | 5x10=50 | 8x16=128 | 4x8=32 | 7x10=70 | 6x12=72 | 3x8=24 | 9x11=99 |
| $C_2$ | 45 | 112 | 36 | 84 | 84 | 30 | 108 |
| $C_3$ | 45 | 128 | 36 | 70 | 84 | 27 | 117 |
| $C_4$ | 50 | 120 | 36 | 91 | 84 | 24 | 108 |
| $C_5$ | ~~50~~ 50 | 128 | 28 | 84 | 84 | 27 | 108 |
| $C_6$ | 60 | 112 | 28 | 70 | 84 | 27 | 117 |

| F1 | F2 | F3 |
|---|---|---|
| 5+4+9=18 | 7+3=10 | 8+6=14 |
| 7+6=13 | 8+4+9=21 | 5+3=8 |
| 6+3=9 | 4+7=11 | 5+8+9=22 |
| 5+8+6=19 | 4+3+9=16 | 7 |
| 5+7+6+3=21 | 9 | 8+4=12 |
| 6+3=9 | 5+8+7=20 | 4+9=13 |

$C_1 = 50 + 128 + 32 + 70 + 72 + 24 + 99 = 475$

$C_2 = 499$

$C_3 = 507$

$C_4 = 513$

$C_5 = 509$

$C_6 = 498$

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⇒ Roulette Wheel Selection:

| | Inverse | Probability |
|---|---|---|
| $C_1$ | 1/475 = 0.002105 | 0.002105/0.012003 = 0.1753 |
| $C_2$ | 1/499 = 0.002004 | 0.002004/0.012003 = 0.1669 |
| $C_3$ | 0.001972 | 0.1643 |
| $C_4$ | 0.001949 | 0.1624 |
| $C_5$ | 0.001965 | 0.1637 |
| $C_6$ | 0.002008 | 0.1673 |
| Total = | 0.012003 | |

⇒ $C_1$, $C_2$, and $C_6$ are favored due to their lowest costs.

⇒ Crossover:

Pair 1:

$C_1 = [1, 3, 1, 2, 3, 2, 1]$ } Offspring 1 = [1, 3, 2, 1, 1, 3, 2]

$C_2 = [3, 2, 2, 1, 1, 3, 2]$ } Offspring 2 = [3, 2, 1, 2, 3, 2, 1]

Pair 2:

$C_1 = [1, 3, 1, 2, 3, 2, 1]$ } Offspring 3 = [1, 3, 1, 2, 1, 1, 3]

$C_6 = [2, 2, 3, 2, 1, 1, 3]$ } Offspring 4 = [2, 2, 3, 2, 3, 2, 1]

Pair 3:

$C_2 = [3, 2, 2, 1, 1, 3, 2]$ } O5 = [3, 2, 2, 1, 1, 1, 3]

$C_6 = [2, 2, 3, 2, 1, 1, 3]$ } O6 = [2, 2, 3, 2, 1, 3, 2]

⇒ Mutation:

O1 = [1, 3, 2, 1, 1, 3, 2]

O2 = [3, 2, 1, 2, 2, 3, 1] {Swapped position 4 and 5}

O3 = [1, 1, 2, 1, 3, 3] {Swapped position 1 and 5}

O4 = [2, 2, 3, 2, 3, 2, 1]

O5 = [3, 2, 2, 1, 1, 1, 3]

O6 = [2, 2, 3, 2, 1, 3, 2]

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⇒ Fitness of new population:

| | T1 | T2 | T3 | T4 | T5 | T6 | T7 | F1 | F2 | F3 |
|---|---|---|---|---|---|---|---|---|---|---|
| $O_1$ | 60 | 120 | 36 | 84 | 84 | 30 | 108 | 18 | 13 | 11 |
| $O_2$ | 45 | 112 | 32 | 70 | 70 | 30 | 99 | 13 | 21 | 8 |
| $O_3$ | 50 | 120 | 32 | 70 | 84 | 30 | 117 | 23 | 7 | 12 |
| $O_4$ | 60 | 112 | 28 | 70 | 72 | 24 | 99 | 9 | 323 | 10 |
| $O_5$ | 45 | 112 | 36 | 84 | 84 | 27 | 117 | 16 | 12 | 14 |
| $O_6$ | 60 | 112 | 28 | 70 | 84 | 30 | 108 | 6 | 29 | 7 |

Fitness:

$O_1$ = 503

$O_2$ = 465

$O_3$ = 520

$O_4$ = 466

$O_5$ = 505

$O_6$ = 492

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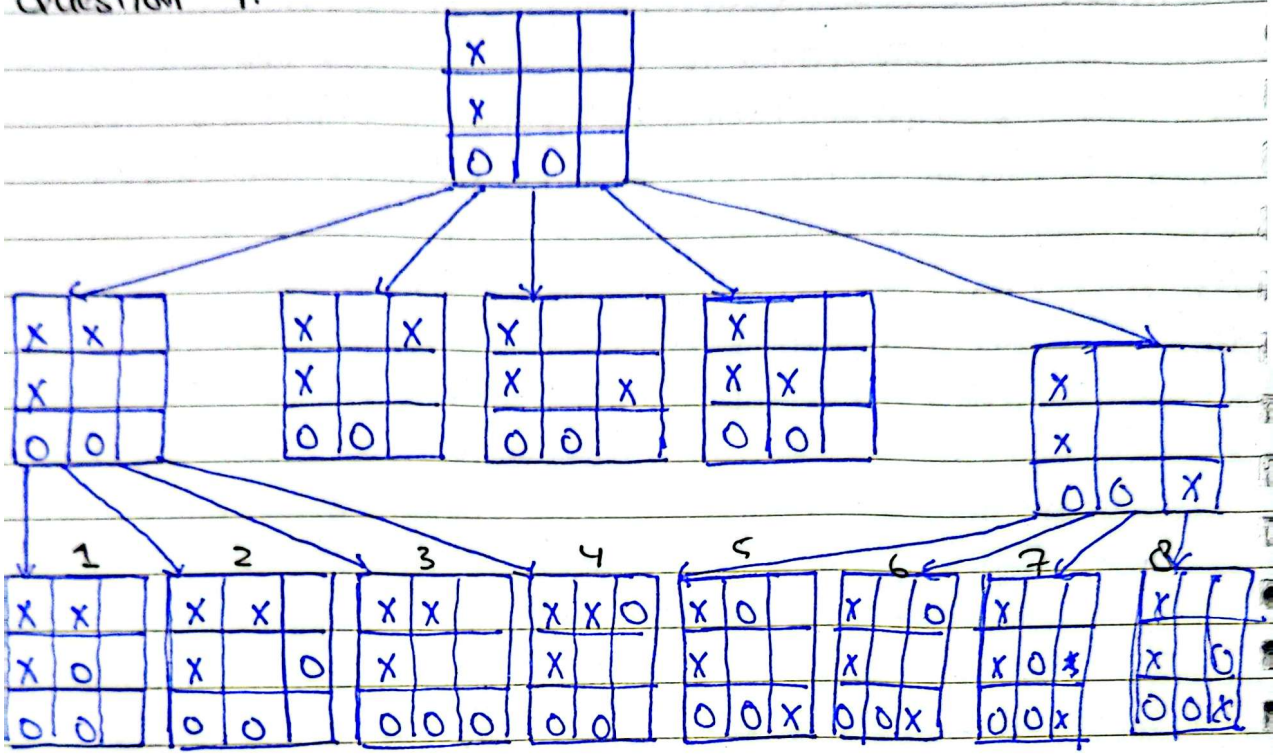
Question 4:




| States | R1 | R2 | R3 | C1 | C2 | C3 | D1 | D2 | ΣR | ΣC | ΣD | Σ(R,C,D) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S1 | 100 | 0 | -100 | 0 | 0 | 0 | ~~-100~~ 0 | -100 | 0 | ~~-100~~ 0 | -100 | -100 |
| S2 | 100 | 0 | -100 | 0 | 0 | -10 | 10 | -10 | 0 | -10 | 0 | -10 |
| S3 | 100 | 10 | -1000 | 0 | 0 | -10 | 0 | -10 | -890 | -10 | -10 | -910 |
| S4 | 0 | 10 | -100 | 0 | 0 | -10 | 10 | -100 | -90 | -10 | -90 | -190 |
| S5 | 0 | 10 | 0 | 0 | -100 | 10 | 100 | -10 | +10 | -90 | 90 | +10 |
| S6 | 0 | 10 | 0 | 0 | -10 | 0 | 100 | -100 | 10 | -10 | 0 | 0 |
| S7 | 10 | 0 | 0 | ~~-100~~ 0 | -10 | 10 | ~~-100~~ 0 | -100 | ~~-90~~ 10 | ~~+90~~ -90 | -100 | -180 |
| S8 | 10 | 0 | 0 | 0 | -10 | 0 | 100 | -10 | 10 | -10 | 90 | 90 |

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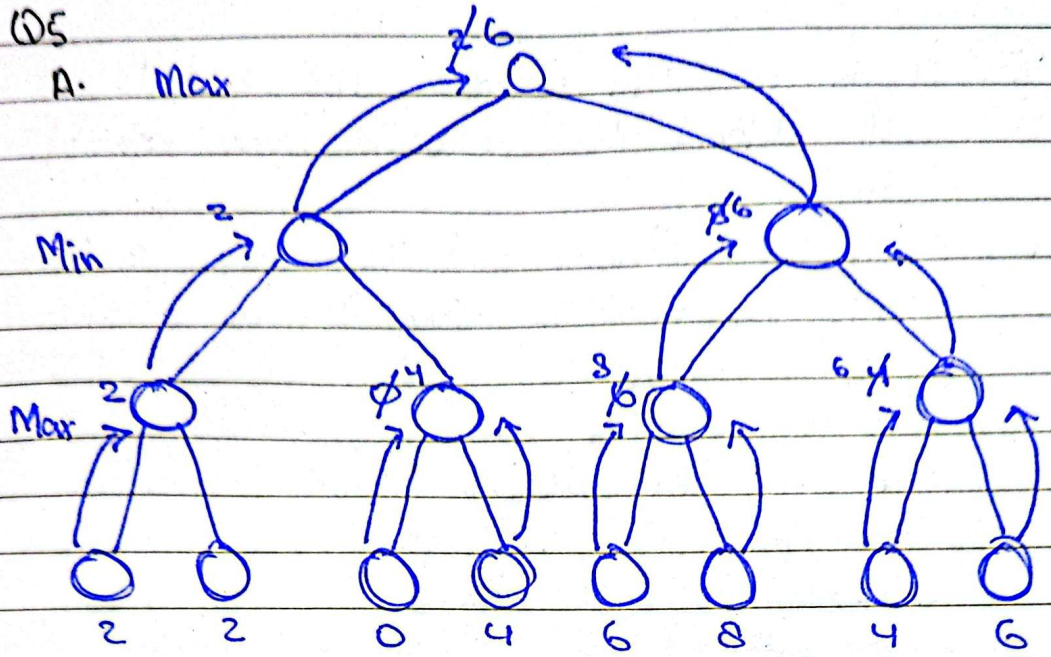
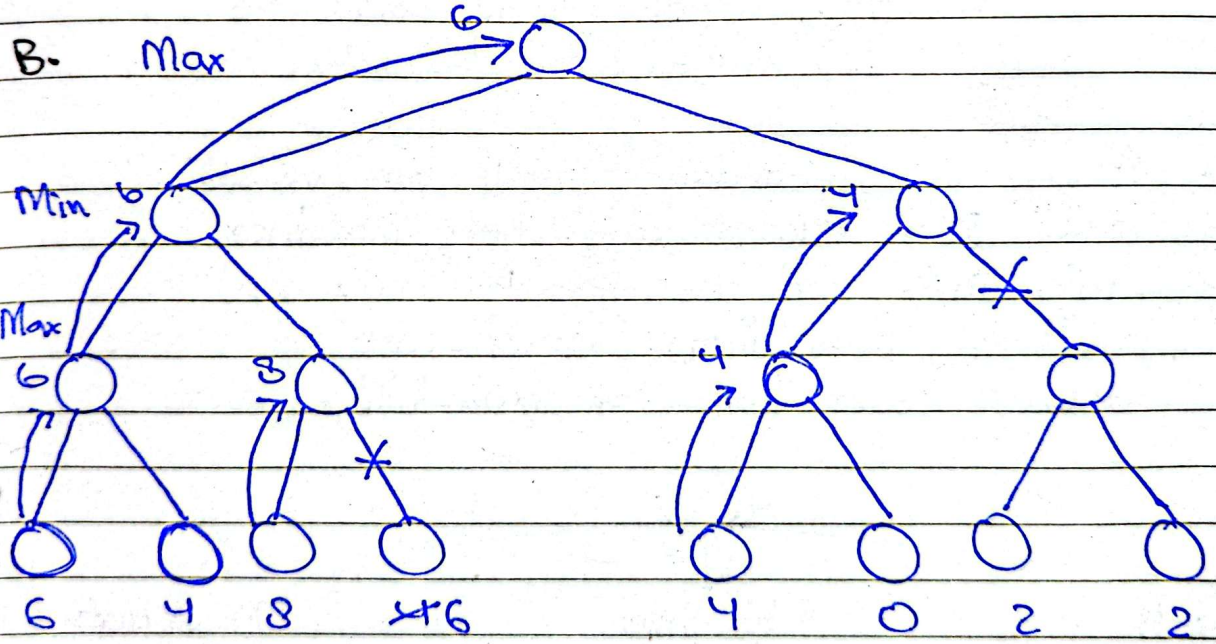
Q5

A. Max




B. Max



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Q6 (a)

1. Max §: It is an AI-powered IDS which will defend the network from external attacks.

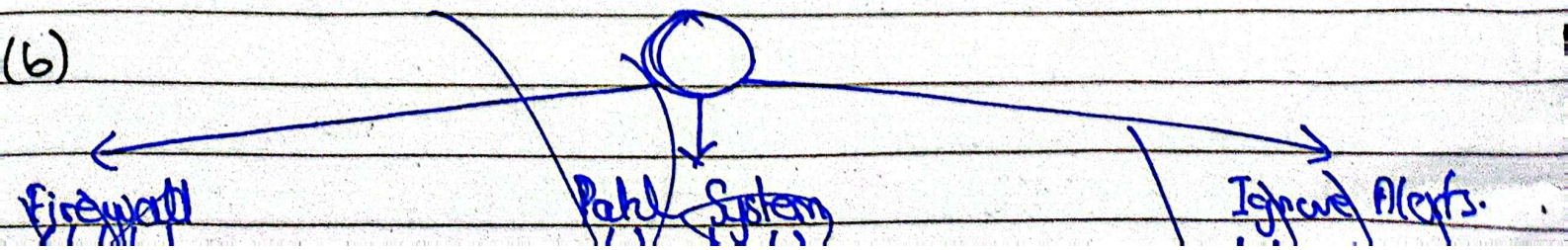
   Min: It is the attacker and its goal is to breach the network using various attacks.

2. Max: It uses strategies such as, ~~deploying~~ implementing firewalls, patching systems to minimize the damage caused while maintaining costs.

   Min: It uses attacks like Brute-force, Phishing, zero-day exploit to maximize the damage caused to the network.

3. Attacks like zero-day exploit are probabilistic with 50% success rate. They introduce uncertainty, and the defender may need to shift the focus from worst case to average case based on probability.

(b)



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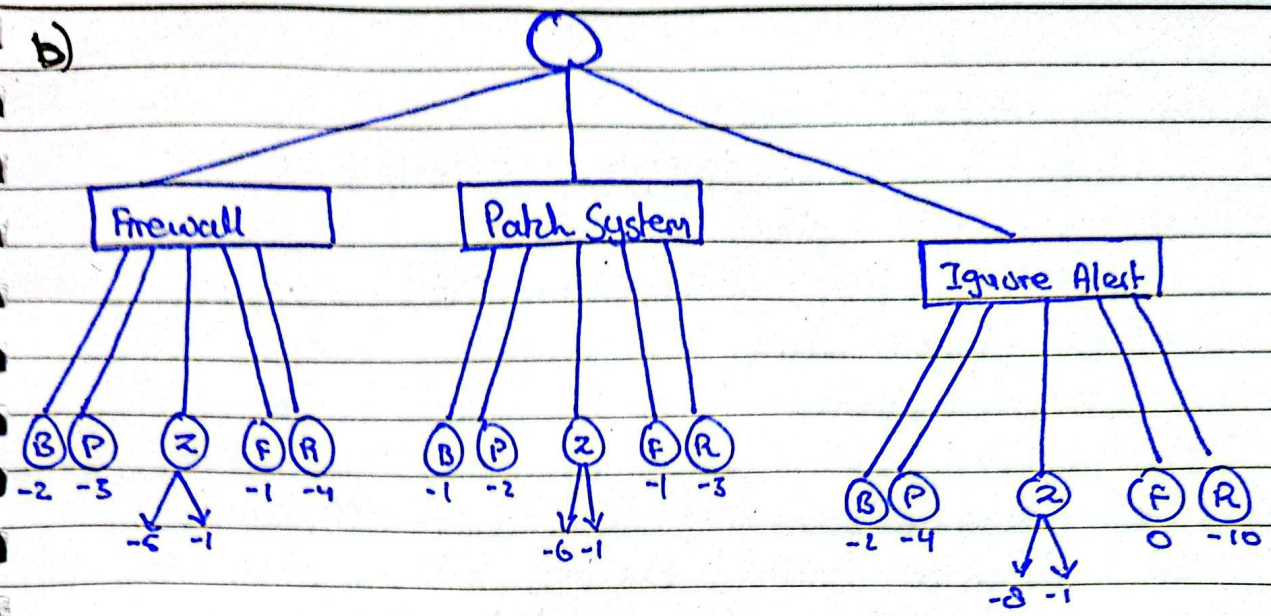
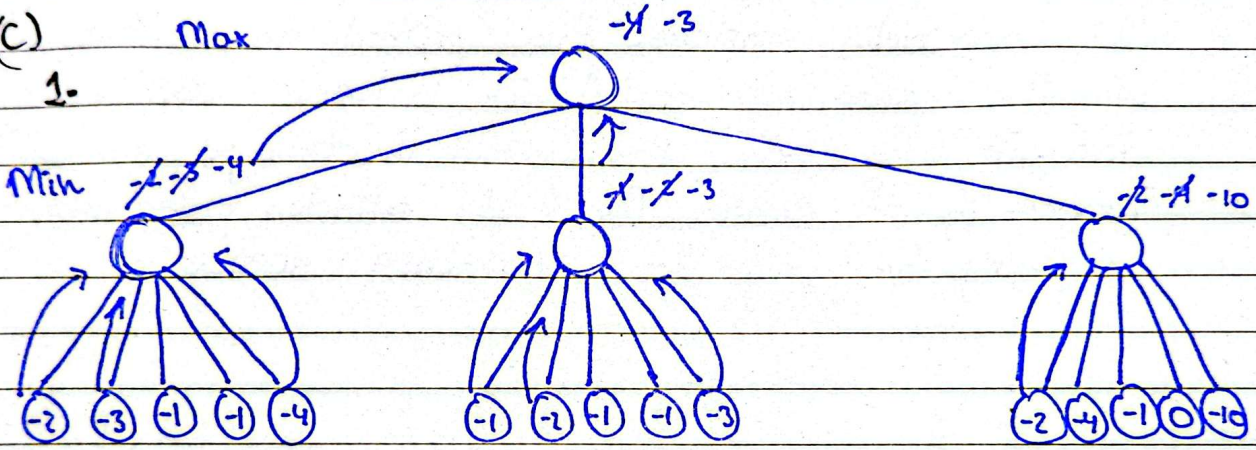
b)



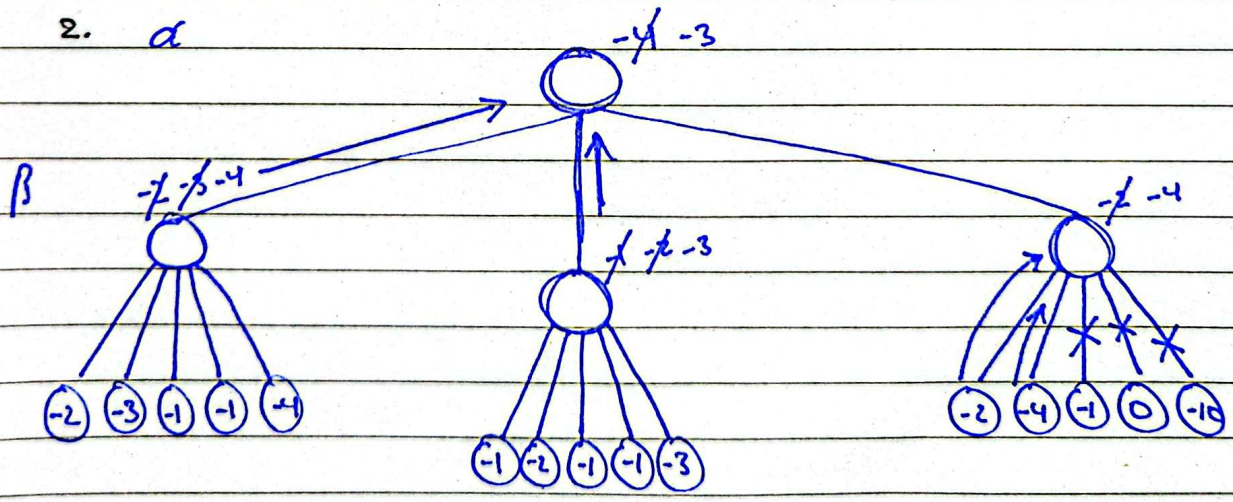

(C) Max

1.




2. α

β



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d)

1. ⇒ For deploy firewall:
   expected value = (0.5x-5)+(0.5x-1) = -3
   ⇒ For patch system:
   expected value = (0.5x-6)+(0.5x-1) = -3.5
   ⇒ For ignore alerts:
   expected value = (0.5x-8)+(0.5x-1) = -4.5

2). When using Expectimax instead of Minimax, the defender should choose Patch System as its provides the best expected utility (-3.5). This approach considers the probabilistic nature of the zero-day exploit. It balances risk by accounting for both the potential damage and probability of success for each attack, rather than preparing for only the worst-case scenarios.

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Question 3:

The code generated by chatgpt is more robust and maintainable due to the MRV heuristic integration and better domain representation via sets, while my code does not make use of heuristics.

My code can be improved by integrating MRV which will improve performance. Moreover, dictionary based domains can be replaced with set-based ones, this will ensure quicker look-ups.